

I CLAIM:

1. A method of estimating P-wave velocity in a near-surface region of a land area, comprising:

a first step of gathering control data for the near-surface region;

a second step of gathering vibrator dynamic data generated in the near-surface region in response to vibrator action on the land area; and

a third step of estimating the P-wave velocity in response to both the control data and the vibrator dynamic data.

2. The method of claim 1, wherein the vibrator dynamic data includes at least one of ground stiffness data and ground viscosity data.

3. The method of claim 2, wherein the vibrator dynamic data includes both the ground stiffness data and the ground viscosity data.

4. The method of claim 3, wherein the vibrator dynamic data includes P-wave velocity information derived by the steps of calculating shear wave propagation velocity information from the ground stiffness data and the ground viscosity data and then calculating the P-wave velocity information from the calculated shear wave propagation velocity information in combination with an estimate of Poisson's ratio.

5. The method of claim 3, further comprising an initial step of selecting the land area such that the land area includes adequate upholes to ensure good statistical representation of the selected land area near surface variations.
6. The method of claim 3, wherein said first step includes the step of uphole data preparation and quality assessment.
7. The method of claim 3, wherein said second step includes the step of conducting a 3-dimensional seismic study in the land area.
8. The method of claim 3, further comprising a step of gathering surface elevation information of the land area to be used in said third step.
9. The method of claim 1, wherein said first and second steps may be performed in any order and/or at least partially concurrently.
10. The method of claim 1, wherein said third step includes the step of building a 3-dimensional near-surface velocity model by the steps of:
 - deriving uphole velocity information from the seismic data gathered in said first step;
 - deriving velocity attribute information from the vibrator dynamic data gathered in said second step; and

integrating the uphole velocity information using collocated cokriging with the velocity attribute information.

11. The method of claim 10, wherein said building step further includes the steps of:

building an initial 3-dimensional near-surface velocity model by 3-dimensional kriging of the uphole velocity information to generate additional information; and
using the additional information in said integrating step.

12. The method of claim 10, further comprising the step of applying static corrections to results from said integrating step.

13. The method of claim 1, wherein the control data gathered in said first step is seismic data based upon waves in the near-surface region generated in response to a shock in each of a plurality of upholes drilled in the land area.

14. The method of claim 13, wherein the vibrator dynamic data includes at least one of ground stiffness data and ground viscosity data.

15. The method of claim 14, wherein the vibrator dynamic data includes both the ground stiffness data and the ground viscosity data.

16. The method of claim 15, wherein the vibrator dynamic data includes P-wave velocity information derived by the steps of calculating shear wave propagation velocity information from the ground stiffness data and the ground viscosity data and then calculating the P-wave velocity information from the calculated shear wave propagation velocity information in combination with an estimate of Poisson's ratio.

17. The method of claim 15, further comprising an initial step of selecting the land area such that the land area includes adequate upholes to ensure good statistical representation of the selected land area near surface variations.

18. The method of claim 15, wherein said first step includes the step of uphole data preparation and quality assessment.

19. The method of claim 15, wherein said second step includes the step of conducting a 3-dimensional seismic study in the land area.

20. The method of claim 15, further comprising a step of gathering surface elevation information of the land area to be used in said third step.

21. The method of claim 13, wherein said first and second steps may be performed in any order and/or at least partially concurrently.

22. The method of claim 13, wherein said third step includes the step of building a 3-dimensional near-surface velocity model by the steps of:

deriving uphole velocity information from the seismic data gathered in said first step;

deriving velocity attribute information from the vibrator dynamic data gathered in said second step; and

integrating the uphole velocity information using collocated cokriging with the velocity attribute information.

23. The method of claim 22, wherein said building step further includes the steps of:

building an initial 3-dimensional near-surface velocity model by 3-dimensional kriging of the uphole velocity information to generate additional information; and

using the additional information in said integrating step.

24. The method of claim 22, further comprising the step of applying static corrections to results from said integrating step.